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NOTES ON THE LIFE-HISTORY OF THE FOUR-BANDED LEAF-ROLLER, EULIA QUADRIFASCIANA FERN. (LEPID.)*

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The four-banded leaf-roller, *Eulia quadrifasciana* Fern., is very closely related and similar in habits to the red-banded leaf-roller, *Eulia velutinana* Walk. It was described by Fernald (1882)[1] as *Lophoderus quadrifasciana* but was later placed in the genus Eulia by Kearfott (1905)[2]. Fernald (1908)[3] put *Lophoderus* Steph., in synonymy with *Eulia* Hubn. For at least eight years following the original description it seems to have attracted little attention. Sanderson (1904)[4] recorded it for the first time as a pest of apple in Delaware. The same year Fletcher (1900)[5] reported it somewhat abundant in Canada. Subsequently it has been recorded from Maine, New Hampshire, Massachusetts, New York, Pennsylvania, Delaware, Illinois and it is apparently common throughout north eastern United States. It has been found somewhat common in Pennsylvania by the writer (1922)[6] who mentions it in connection with *Eulia mariana* Fern., as a pest of apple.

During 1922 and 1923 the writer had an opportunity of securing some life-history notes on this species. The comparative lack of information in literature concerning the habits of this species, warranted some study. Its similarity to *Eulia velutinana* is noteworthy.

The species hibernates as pupae beneath the bark of apple or within dried leaves or other rubbish upon the ground. Dr. O. A. Johannsen (1912)[7] bred the adult from a larva taken under the bark of apple. No date was indicated but possibly the larva was collected in the fall. ,

During March or early April, the adults emerge and lay their eggs on the trunks and larger branches of the apple. A few adults were reared from hibernating pupae which were sifted from trash taken beneath apple trees. No records were kept of the habits of the larvae of the first generation.

The larvae mature towards the end of May and transform to pupae. The following scanty records suffice to indicate the termination of the first generation and the beginning of the second. Eight pupae were formed on May 31st. No pupae had been observed previous to this in the orchard and these were probably the earliest individuals to transform. Adults from these pupae emerged from June 11th to June 14th, giving a pupal period of eleven to fourteen days.

Copulation was observed more often in this species than in *Eulia velutinana*. It was a common occurence to see a pair in copulation shortly after they emerged in confinement. In the orchard they were also seen frequently in copulation. They seem to avoid the intense heat of the day and their activities are more pronounced towards the evening or early morning.

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Second generation.

A few days after emergence, the adults mate, lay eggs for a second brood and these hatch in seven to ten days. Adults at the insectary commenced laying eggs on June 13th, and continued laying until June 27th. Individual adults lived for but six or seven days and the males usually died sooner than the females. In a few experiments, 828 eggs were laid by fourteen females. Four of the females laid more than a hundred eggs apiece, the largest number being 146 eggs. These figures give some idea of the activities of the adults but represent egg laying only during the early part of the brood. No doubt egg laying would continue until July and the reproductive capacity would probably exceed these records.

The hatching of a few eggs was observed. Seven batches, comprising over 450 eggs were laid between June 13th and June 16th. These hatched on consecutive days from June 22nd to June 28th, which gives a minimum incubation period of seven days, a maximum of ten days, and an average of eight and a half days.

The eggs resemble those of *Eulia velutinana*, they are flattened like all the eggs of Torticidae and laid in overlapping masses varying from eighty to one hundred in a mass. They are pale greenish yellow in color and somewhat transparent. The embryo can be readily seen developing within the egg.

A series of forty four eggs hatching over a short period from June 22nd to June 26th, were placed in rearing jars and fed fresh apple leaves every day. These larvae transformed between July 1st and August 13th. The shortest larval period was twenty-eight days, the longest forty-five days and the average thirty-six and a half days.

At present the writer is unable to distinguish between the larvae of *Eulia quadrifasciana* and *E. velutinana*. Both are yellowish green in color including the head and cervical shield and there are no distinctive markings. Further studies may reveal structural characters for separating them. The larvae of *E. quadrifasciana*, however, feed more openly, spin less silk and eat holes clear through the lower epidermis when feeding from the upper surface of the leaf.

The larvae, especially of the first and second broods, feed largely on the water sprouts, the young tender foliage and the growing tips of the apple. They were found numerous on early varieties of apples as the Yellow Transparent and often attacked the fruit eating shallow cavities into the surface in the same manner as the larvae of *E. velutinana*.

The first pupae of the second generation were found on July 21st. Larvae continued to transform at the laboratory until August 13th. In their natural position in the orchard they were found somewhat exposed on leaves and protected only by a few strands of silk. They are chestnut brown in color with greenish wing pads and resemble in size and color those of *E. velutinana*. A record of thirty individuals studied at the insectary showed a minimum pupal period of six days, a maximum of twenty days and an average of nine and three tenths days. Only a single abnormal individual had a pupal period of twenty days.

The adults started emerging on August 2nd and were still emerging on September 2nd. It is doubtful whether the late emergers would succeed in producing another brood but those issuing during August produced a third generation.

The adults are very conspicuous in the orchard due to their bright color. The fore wings are yellow with distinct orange blotches. Across the wings in a diagonal manner, run two dark bands from which the species takes its name. These are more pronounced in the male than in the female. Considerable variation exists as to the intensity of these bands and in some females they are scarcely visible. The hind wings are grey in color.

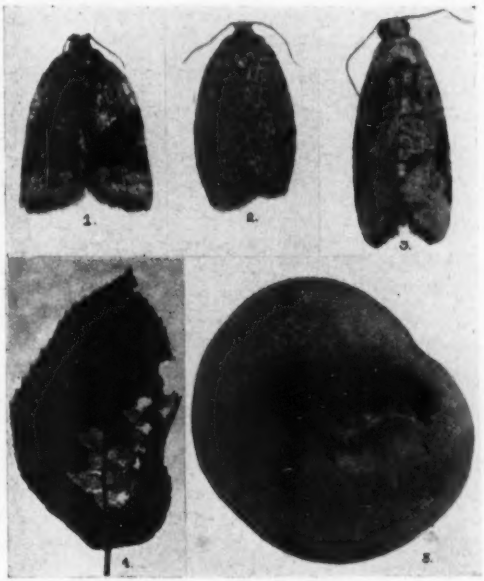

Fig. 1. *Eulia velutinana* Walk. Fig 2. *Eulia quadrifasciana* Fern. Fig. 3. *Eulia mariana* Fern. Fig. 4. Typical injury of *E. quadrifasciana* on foliage. Fig. 5. Typical injury of *E. velutinana* on fruit.

Adults were seen flying almost continually in the orchards from June until August. Fletcher & Gibson (1907)[8] states that two specimens were caught at light in Canada. Dr. W. T. M. Forbes of Cornell University, has contributed the following unpublished records from light traps run at Ithaca, N. Y. During 1922 he collected one adult on June 29th and during 1924 he caught two adults on July 12th, one on July 21st., and one on July 24th. The writer has taken the adults of this species as well as *E. velutinana* from pails containing sugar baits. Such baits hung in apple orchards attract large numbers, especially of *E. velutinana*.

Third generation.

Detailed information is not available for the third generation. Its beginning is marked by the egg laying records obtained from a few adults; twenty pairs of moths emerging between August 6th and 8th, were placed in rearing cages. A total of 907 eggs were deposited by the females, which shows that there is a distinct third brood. Orchard records on August 9th revealed many full grown larvae and numerous pupae present. These were, no doubt, the first individuals to

seek hibernating quarters. The majority of the larvae would apparently not transform until the first of September.

No parasites, as far as the writer is aware, have been reared from *E. quadrifasciana* but due to its similarity in habits to *E. velutinana*, the parasites of the one would probably readily attack the other. Several parasites have been recorded as attacking *E. velutinana*.

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THE LEPIDOPTERA OF THE SETON LAKE REGION, BRITISH COLUMBIA.*

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In the early summer of 1926 I spent nearly two months in the vicinity of Lillooet, B. C., a typical "dry-belt" locality, studying the insect fauna of this region. My headquarters were at Craig Lodge, at the east end of Seton Lake, a large body of water about three miles west of Lillooet draining into the Fraser River through Seton Lake Creek, which is joined about a mile to the east by the larger Cayoosh Creek, entering from the south through the deep and precipitous Cayoosh Canyon. The general nature of the country has already been ably indicated by Mr. R. Glendenning in a paper on the Fauna and Flora of Mt. McLean which appeared in the Proceedings of the British Columbia Entomological Society for 1921.

Most of my collecting was done at the lower levels, between 800 and 1500 ft., but on July 10th a three days' trip to Mt. McLean was made and the highly satisfactory results of this excursion are also incorporated in my list: collections were further made at D'Arcy, at the south end of Anderson Lake, certain species being found here which were not seen at Seton Lake; almost the entire Noctuidae and Geometridae were taken at light on the verandah of Craig Lodge.

While it is fully realized that this list must, of necessity, be incomplete, there being doubtless many early spring and late summer and fall species which were missed, still, in view of the interesting nature of the lepidopterous fauna of this region, it is felt that even a partially complete list will be of value and serve as a basis for future investigations.

DIURNALS

PAPILIONIDAE

Papilio bairdi form *oregonia* Edw. Probably not uncommon along the flats of the Fraser River, south of Lillooet. I discovered the collecting ground too late in June to secure more than a few worn males and a perfect female. Mr. A. W. A. Phair of Lillooet tells me there is a partial second generation later in the summer.

*—Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.

Papilio zelicaon Bdv. Not very common in June along the railway track bordering Seton Lake. Mr. Phair has taken it on Mt. McLean at 4500 ft. altitude and I also secured a specimen at D'Arcy at the upper end of Anderson Lake (June 17). Mr. N. Criddle bred a large female from a larva found on *Heracleum lanatum* in August at Barkerville, a couple of hundred miles north of Lillooet.

Papilio rutulus Luc. Common throughout the region in late May and June.

Papilio daunus Bdv. Equally common along with *rutulus*, but slightly later in time of flight. I observed a female depositing ova on an *Amelanchier* bush.

Papilio eurymedon Luc. Common in late May and early June. The females were seen ovipositing on alder bushes.

Parnassius clodius gallatinus Stich. I captured a small, but very interesting series of this race of *clodius* at Alta Lake, Mons, a small lake at the summit of the pass through the Coast range on the P. G. E. Railway, at about 2000 ft. altitude. Most of the males show the dark band joining the discal spot to the spot on the middle of the inner margin, but as I formerly surmised (Cont. IV, 62) this is not constant; there is also great variability in the size of the red spots of secondaries and the distinctness of the submarginal black lunules. It would seem best to use the name *gallatinus* for the smaller mountain form which bears the same relation to *claudianus* that *baldur* does to *clodius* proper; we have the same form from the Hope Mountains (Hedley region) and it probably occurs at moderate elevations all through this section of the country.

Parnassius smintheus Dbldy. Very common on July 11th on Mt. McLean, above Lillooet, between 5000 and 6500 ft. altitude but not occurring in the valleys. The specimens seem fairly typical in size and, although there is a considerable tendency in the series toward reduction of the red spots of secondaries, I found none that could be referred to ab. *nanus* Neum. either in lack of red or in smallness of size. In the original description Neumoegen gives as type locality, Spence's Bridge, a small settlement in the valley of the Thompson river, near its junction with the Fraser; the specimens probably came from high in the mountains near by either this town or Lytton and certainly were never taken in the dry valley; specimens of the size of those on which the name *nanus* was based (1¾ in. expanse) are scarcely ever found lower than 7000 ft. and evidently represent the form of the highest altitude in the Canadian Rockies and adjacent ranges at which the species can exist; they generally are on the wing in late July and August.

PIERIDAE

Pieris occidentalis Reak. An odd specimen or two was seen early in June around Seton Lake; the species was commoner at higher altitudes on Mt. McLean in mid-July.

Eurymus nastes streckeri Gr. Gr. This race of *nastes* was not uncommon on the higher slopes of Mt. McLean (above 6500 ft.) on July 12th, but very hard to capture; both sexes in my small series show even more tendency towards extension of the yellowish areas than is found in typical specimens from the Laggan region. One male before me has practically lost all traces of both black powdering and black border except at base of wings and very faintly at

apex of primaries; the discal spot on upper side of primaries is also wanting, the whole upper surface (with the exceptions noted above) being pale greenish yellow with pink fringes. For this aberration I propose the name ab. PALLIFLAVA, it representing the extreme form of development in the opposite direction to ab. *obscurata* Verity; type No. 2425 in the Canadian National Collection, Ottawa.

Eurymus alexandra emilia Edw. A single female of this race was taken on the Fraser flats on June 14th; the species was very abundant on June 17th at D'Arcy at the upper end of Anderson Lake, collecting around moist patches in the road; its natural haunts, however, were the open spaces on the pine-clad slopes bordering the valley. A long series of females before me are all pale whitish in color, and this appears to be the normal form in this region; it has recently been named form ♀ *hatui* by Barnes and Benjamin.

Eurymus eurytheme eriphyle Edw. Not uncommon around the alfalfa fields in the Fraser valley in June.

Anthocharis sara stella Edw. Two specimens were captured on the way up Mt. McLean on July 11th at about 4000 ft.

SATYRIDAE

Cercyonis silvestris paulus Edw. Common during the last week of June and early July along the railway track bordering Seton Lake.

Oeneis nevadensis Feld. A pair of this species was taken at D'Arcy on June 17th; I believe it occurs also near Seton Lake, but I saw no specimens. My specimens show the heavily suffused underside of secondaries similar to the Vancouver Island form, for which the name *gigas* Butl. is available, if desired.

Oeneis chryxus Dbldy. A single large female was taken on a rock-slide in Texas Creek 12 miles south of Lillooet on June 15th; several males were seen but not secured; the species is also said to occur up Cayoosh Creek, but I did not see any specimens. On Mt. McLean the species is much more common, being found not only on the grassy slopes near timber-line but also on the bare knolls at 6000 ft. or more altitude; there is considerable variation in the depth of coloration and the distinctness of the banding on the underside of the hind wings.

Oeneis beani Elwes. Not uncommon on the very highest slopes of Mt. McLean, at 7500 ft. altitude, but difficult to capture owing to the generally prevailing high winds. On July 12th I secured a series of six males and one female.

Erebia vidleri Elwes. Not uncommon in the open woods near timber-line on Mt. McLean in July; this is the type locality for the species.

NYMPHALIDAE

Argynnis hydaspe rhodope Edw. This race was described from specimens taken by Crotch near 100 Mile House on the old Cariboo Trail, about 75 miles north east of Lillooet and at about 2500 ft. elevation (*vide* Edwards Butt. N. Am. II, Arg. VI). In the Lillooet region itself I saw no Argynnids in the valley but at D'Arcy I secured one female on June 17th which matches excellently Edward's figure in the above mentioned volume both as to size and as to depth of color on the underside of the secondaries; unfortunately no other specimens were seen, probably owing to the cool cloudy weather which prevailed. The Vancouver Island form with which the name *rhodope* is generally associated, may possibly be slightly darker in color but is close enough, as far as my present knowledge goes,

to warrant this determination. *Sakuntala* Skin. (there is already unfortunately a *sakontala* Koll. in the genus) is applicable to the form found in the Selkirks and main chain of the Rockies and appears quite prevalent in southern British Columbia (Kootenay); in general it is slightly smaller in size and paler in color, notably on the underside of secondaries, but it is a variable form and Skinner's points of distinction from *rhodope* do not always hold. In the higher altitudes it becomes slightly smaller but not sufficiently so to warrant a name in my opinion. However, in the open spaces near timber-line on Mt. McLean (5000 ft.) I met with a small form quite commonly for which I propose the term *rhodope* form. alt. ***minor,*** the wing expanse being about 1¾ in. as compared with 2¼ in. for *rhodope* and 2 in. for *sakuntala;* in coloration this form resembles *rhodope* quite closely, although, as usual, there is considerable variation and some specimens approach *sakuntala* in the paleness of the submarginal band of the underside of secondaries; the marginal lunules are usually well-silvered. This mountain form will probably be found all through the Cascade and Coast ranges at suitable elevations as I have single specimens before me both from the Hope Mountains (Hedley) and Grouse Mountain near Vancouver.

Holotype—♂, Mt. McLean, B. C., June 12, 11926, (J. McDunnough).

Allotype—♀, same data.

Paratypes—2♂, 1♀, same data; 1♂ Lillooet, B. C., 4600 ft, July 14, 1916; 1♂ McGillivray Creek, Anderson Lake, B. C., Aug. 9, 1916; No. 2427 in the Canadian National Collection, Ottawa.

Argynnis bischoffi opis Edw. This race was described from material taken by Crotch on Bald Mountain near Lake La Hache on the old Cariboo Trail, about 100 miles north of Lillooet; on Mt. McLean above timber line I took a series of what appear to be quite typical specimens (unsilvered spots on underside) along with an equal number of other specimens in which the spots were well-silvered and which can hardly be separated from *washingtonia* B. and McD. from Mt. Ranier. *Opis* will probably occur on all the high mountains of the Coast and Cascade Ranges; I have series before me from Barkerville, Hedley, and Mt. Cheam, B. C. which contain both forms; I also captured it on the summit of Mt. Revelstoke and have a few specimens from the Banff and Jasper Park regions which would indicate a distribution throughout the whole mountain area of British Columbia and Alberta. It is probably only a high altitude form of *curynome,* distinguished by small size, darker coloration on upper side and heavier green and brown suffusion on underside of secondaries. As a racial form *washingtonia* is scarcely distinct from the silvered forms of *opis* but, as *opis* was based on specimens without silvered spots on the underside, the name could be retained, if desired; apparently in the southern portions of its range the silvered form has become the predominant one.

Brenthis chariclea rainieri B. & McD. A. form of *chariclea* very common above timber line on Mt. McLean seems best referred to *rainieri* B. & McD. The males are slightly smaller and darker than Mt. Ranier specimens but the females show the characteristic pale marginal spots; on the underside my series of specimens is very variable, some closely approaching typical *rainieri,* others being suffused with either purplish or reddish in the post-discal area of secondaries; the shape and coloration of the median band varies slightly in almost every specimen.

In view of this extreme variability it would seem best to use the term *rainieri* for the race inhabiting the entire Cascade and Coast ranges; Mt. Cheam specimens are very close to Mt. Ranier ones but certain specimens connect up with my Mt. McLean series; I also have a series from the vicinity of Hedley.

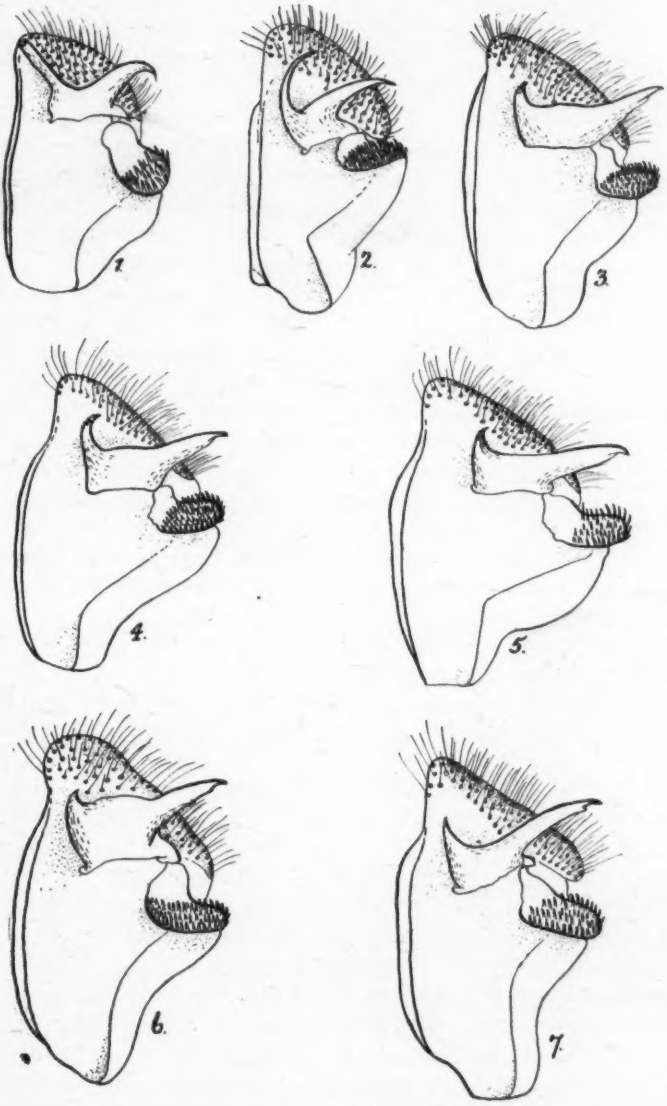
Brenthis epithore Bdv. Although I saw no specimens of this species in the Lillooet region proper I might mention its occurrence, for the sake of distributional records, at Alta Lake, Mons, in early June.

Brenthis astarte Dbldy & Hew. Three specimens were taken on Mt. McLean. The species was not common and, as usual, hard to catch.

Euphydryas beani Skin. Common on the higher slopes of Mt. McLean above timber line on July 11th but already rather worn and hard to secure in good condition. There is considerable variation in size, some of the larger specimens approaching *colonia* Wgt. in wing-expanse; the best point of distinction is apparently found in the median yellow band of the upper side of secondaries which in *beani* is much narrowed, the spots composing it being scarcely longer than broad; *colonia*, on the other hand, has these spots much longer than broad, approaching in this respect *baroni* Edw. but having the submarginal row of spots on primaries red instead of yellow. In an attempt to work out the relationships of this puzzling group I have made a number of genitalic slides, but find that all the so-called species between Nos. 208 and 213 of the Barnes and McDunnough Check List have the male genitalia so extremely similar, that they might easily be considered races or varieties of a single species; until we know the life-history and larval food-plants it seems mere guess-work to attempt any classification more definite than our present one. This group is at once separated from all the other species at present listed under *Euphydryas* by the reduced uncus in the male genitalia which is represented by two short blunt projections, widely spaced; in the other group the bifid uncus is much more developed and consists (except in *phaeton* and *gilletti*) of two curved, claw-like hooks; there are also essential differences in the form of the harpe which can be seen on referring to my figure of the clasper of *taylori*. In our specific arrangement it would seem that this first group should be placed either at the beginning or end of the listed species as otherwise, as in the present lists, it separates species which are evidently very closely related.

Euphydryas perdiccas Edw. The identity of a species of *Euphydryas* which frequented rock-slides at moderate levels, chiefly in Cayoosh Creek Canyon, and was already past its prime on my arrival at Seton Lake on May 26th has proved very puzzling. It has necessitated a careful genitalic study of our entire British Columbian and Rocky Mountain material combined with considerable material from the Western States and has been productive of some rather curious results.

In the first place it became necessary to determine as accurately as possible the identity of *perdiccas* Edw., a species described in Papilio I, 44, 1881; the obvious typographical error, *perdiceas*, in the original description was corrected to *perdiccas* on page 82 of the same volume and the locality of "Mount Hood, Oregon" given as the type locality, was corrected by the collector, Morrison, in Vol. III, p. 43 of the same journal to "prairies around Puget Sound, Washington, especially common near Tenino." I have been unable to examine any material



1. Right clasper of *Euphydryas taylori* Edw. (Victoria, B. C.). 2. Right clasper of *Euphydryas anicia* Dbldy. & Hew. (Banff, Alta.). 3. Right clasper of *Euphydryas perdiccas* Edw. (Victoria, B. C.). 4. Right clasper of *Euphydryas perdiccas paradoxa* McD. (Seton Lake, B. C.). 5. Right clasper of *Euphydryas sierra* Wgt. (Lake Tahoe, Calif.). 6. Right clasper of *Euphydryas colon* Edw. (Corvallis, Oreg.). 7. Right clasper of *Euphydryas chalcedona* Dbldy. & Hew. (San Jose, Calif.).

from this actual locality, but believe, after checking up the original description, that specimens from the vicinity of Victoria, Vancouver Island, British Columbia, which used to be distributed under the name *cooperi* Behr. must represent this species. Edwards in his description of the arrangement of spots on the secondaries states that "the third row is obsolete, or represented partially by a slight cluster of *yellow* scales" and this, combined with the rather dull red underside, seems characteristic. As regards *cooperi* Behr. the identity of this species is still doubtful and I have nothing to add to my note in the Barnes and McDunnough "Contributions," III, 87, 1916. Based on Vancouver Island specimens the male genitalia of *perdiccas* proved to be very similar to those of *chalcedona* and *colon*, showing the same bifid hook-like uncus and the same type of harpe; I figure the inner surface of the right clasper and would call attention to the shortness of the dorsal (or upper) hook of the harpe which at times becomes even more reduced than in the figure.

The identity of *anicia* Dbldy. has already been established by me in the Barnes and McDunnough "Contributions," Vol. III, p. 91, 1916; the species is typical in the main chain of the Rocky Mountains and specimens from the Banff and Laggan regions agreed with the type which I examined in 1913. *Anicia* is a very variable species; in general it differs from *perdiccas* in the much ruddier nature of the spots of the upper side, the yellow being much reduced and either partially or entirely suffused with red; as, however, this condition is not constant, specimens occurring which show the second and third rows of primaries and second and fourth rows of secondaries as clear yellow as in *perdiccas*, I would merely note that the spots in the third row of secondaries are generally well developed, and appear to be always red in color, not yellow. In the male genitalia the main point of distinction from *perdiccas* is found in the much greater length of the dorsal hook of the harpe as shown in my figure from a typical specimen from Banff, Alberta; the other differences between the two figures are largely due to the angle of vision but the above difference appears constant. With this distinction in mind I have examined material from as many localities as were available from the specimens in the Canadian National Collection and arrived at the following distribution for *anicia* in Canada:—ALBERTA: Waterton Lakes, Hillcrest, Banff, Laggan, Morley, Nordegg. BRITISH COLUMBIA: Field, Burgess Pass, Revelstoke, Chase, Kaslo region, Rossland, Cawston, Keremeos, Hedley.

In the eastern portion of its range, notably at Keremeos, due probably to the lower altitude, the species is somewhat larger and the yellow bands of spots more constant and with little tendency to red suffusion, giving a more checkered appearance to the insect; the genitalia show, however, no appreciable difference.

There is a single specimen before me from Kluane, Yukon Territory which agrees quite well with Scudder's description of *helvia*; if my identification is correct *helvia* must be regarded as merely a northern race of *anicia*, scarcely separable from the high altitude specimens of the Banff region or the Colorado form *brucei* Edw. *Wheeleri* Hy. Edw. has also similar genitalia and is evidently the Great Basin form and *bernadetta* Leuss. may be considered as the most easterly race of this same species. On the other hand the genitalia of *sierrae* Wgt. (fig. 5) are distinct from those of *anicia* and show a close relationship to the *perdiccas*

group. I have not had sufficient material to study the *maria-hermosa* group from the south-western States but believe that there is considerable justification for Benjamin's supposition (1926, Bull. S. Calif. Acad. Sci., p. 93) that these may prove to be races of *anicia*.

Returning to the Seton Lake form mentioned previously, I was much surprised to find that male genitalic slides showed the specimens to belong to *perdiccas* rather than to *anicia;* the dorsal hook of the harpe (fig. 4) is generally, (but not always), slightly longer than is found in Vancouver Island *perdiccas* but the relationship is obvious. These Lillooet specimens at times show an obsolescent third row of spots on the secondaries, but generally speaking this row is present as a series of round red spots, not yellow as in the typical form; sometimes these spots show dark central dots and very occasionally a few yellowish scales around the margins, this being more often the case in the females than in the males. From the Keremeos series of *anicia,* mentioned above, I am utterly unable to separate the Lillooet specimens except on genitalic characters; these, however, seem remarkably constant and in order to call attention to this similarity of pattern in races of two apparently distinct species I propose the varietal name PARADOXA for the Lillooet race of *perdiccas*. The types are as follows:—

Holotype—♂, Seton Lake, Lillooet, B. C., June 1st, 1926 (J. McDunnough); No. 2512 in the Canadian National Collection, Ottawa.

Allotype—♀, same locality and collector, June 6, 1926.

Paratypes—18♂, 5♀, same locality and collector, various dates from May 27th to June 6th, 1926; 1♀, Lillpoet, B. C., June 14, 1920 (W. B. Anderson).

On July 11th and 12th I found *perdiccas* very common on Mount McLean from about 6000 ft. elevation upward; the specimens are somewhat smaller than those of the valley region and approach *anicia* in the tendency toward an increase of the red suffusion of the spots; the genitalia, however, are those of *perdiccas*. I have examined specimens from McGillivray Creek, Anderson Lake, taken by C. H. Young in 1916, and others from Mount Cheam from the Bush-Wilson collection and these show a similar type of genitalia; it will probably occur on most of the higher elevations of the Coast and Cascade range, but further inland appears to be replaced by *anicia*.

It is quite probable that it is this form which Gunder has figured from Chilcotin, British Columbia (1926, Ent. News, Pl. I, fig. 5a) and to an aberration of which he has given the name *nigrisupernipennis;* if this be so Gunder's name will unfortunately have to be employed for the high altitude race of *perdiccas;* Barnes and Benjamin, I note, in their latest Diurnal Check List place this name as an aberration of *colon* Edw. Typical *colon,* however, such as is figured by Wright (fig. 156b, as *baroni*) and in Comstock's "Butterflies of California," Pl. 33, fig. 7, and which shows a great reduction of red spotting does not occur in Canada as far as I know, although, judging by the genitalia, there is no reason why *perdiccas* should not be considered as a northern race of *colon*, the genitalia of which I figure from a typical specimen from Corvallis, Oregon; to go a step further all three names could easily be placed on genitalic characters as races of *chalcedona;* a comparison of my figures will show that they all have essentially the same type of harpe. It would almost appear as if we had a Paci-

fic Coast species, *chalcedona*, extending back into the Sierras and Coast Range and producing numerous races, and a Rocky Mountain species, *anicia*, equally rich in forms and extending the entire length of the continent, with branches thrown out east and west of its main area of distribution. A study of material from eastern Washington, Oregon and Idaho, where the two species possibly overlap, should prove most interesting; a knowledge of the larvae is also most essential before deciding on the specific value of these names.

Melitaea palla Bdv. Only a couple of specimens were taken at Seton Lake (June 2, 15) but the species was quite common at D'Arcy, Anderson Lake in the middle of June.

Melitaea damoetas Skin. Plentiful locally on Mount McLean on July 12th; a beautiful female aberration in which the whole upper surface is lightly suffused with blackish, the orange marginal and submarginal lunules and the spots in the cell only showing faintly, as through a haze, was captured; for this specimen I propose the aberration name *damoetella*, the holotype being No. 2433 in the Canadian National Collection, Ottawa.

Phyciodes tharos pascoensis Wgt. Common at D'Arcy, Anderson Lake in mid-June. This western race only differs from the typical eastern form in the slightly more extended orange area of forewings, the black outer margin appearing narrower and the post-median fine black line being obsolescent. These distinctions are not entirely constant.

Phyciodes campestris Behr. Rather uncommon about Seton Lake; much commoner on the trail to Mount McLean between 4000 and 5000 ft.

Phyciodes mylitta pallida Edw. This is the dominant *Phyciodes* of the low levels along Seton Lake and the Fraser. Both in size and tendency to reduction of the black areas the specimens approach *barnesi* Skin. which probably is not a constant race, even in its type locality, Glenwood Springs, Colorado.

Basilarchia lorquini burrisoni Mayn. Common in June both in the valleys and at moderate altitudes on the mountain sides.

Polygonia faunus rusticus Edw. A few specimens were on the wing in Cayoosh Creek, early in July.

LYCAENIDAE

Strymon melinus Hbn. A race of this species was fairly common during June all through the valley. It is most closely allied to the Vancouver Island race which I described as *atrofasciata* but differs in the paler ground-color of the underside, which has a distinct pearly tinge, lacking in *atrofasciata*, and becoming in older and faded specimens almost whitish. The post-median rows of spots are clean-cut on both wings, some specimens showing no trace of interior ruddy shading, others with traces of ruddy on the inner side of the hind wing band, especially noticeable in the first four spots below costa; the red anal and subanal spots are usually rather small, seldom diffuse and touching the postmedian band. As this race seems to be the prevalent one throughout the interior of British Columbia judging by other material before me I propose for it the name SETONIA. In the color of the underside it is apparently close to the Californian var. *pudica* Hy. Edw. but this is stated to have the spots on the primaries obsolete. The type material is as follows:—

Holotype—♂, Seton Lake, Lillooet, B. C., June 21, (J. McDunnough); No. 2502 in the Canadian National Collection, Ottawa.

Allotype—♀, same locality, June 13.

Paratypes—6♂, 7♀, same locality and various dates in June.

Strymon titus form *immaculosus* Comst. A single large male of this species was captured along Seton Lake Creek on June 20th.

Strymon californica Edw. Two males, not in the best of condition, were taken along the railway track bordering Seton Lake on June 20th and July 3rd.

Strymon saepium Bdv. Only a single female of this species was taken at Seton Lake July 3rd; in the Canadian National Collection are other specimens labelled Lillooet, collected by C. H. Young in 1916.

Mitoura nelsoni Bdv. A single female, June 2nd, is the only record; it is probable that the flight of the species was over before I reached Seton Lake.

Heodes snowi Edw. Quite common in spots on Mount McLean above 6000 ft. in early July. Compared with a few rather old and worn Colorado specimens before me, which I presume are typical, this series differs in the brighter orange color on the underside of the primaries, the gray marginal band contrasting quite sharply. This difference may however not hold when a series of fresh Colorado specimens is available for comparison; certain of our Laggan specimens seem to intergrade.

Plebeius scudderi Edw. Not uncommon on Mount McLean in the open meadows below timber-line. The form seems almost typical, the females showing no blue shading in the basal area and only faint orange lunules on the upper side. On June 5th I captured a single, very fresh male on the west bank of the Fraser river on the Texas creek road; this was the only specimen seen at the lower levels.

Plebeius aquilo Bdv. Occurs on the higher slopes of Mount McLean above timber-line. This race, which probably is found on all high elevations of the Cascade Range and extends far into the north, seems worthy of a varietal name and I propose for it the name MEGALO; it approaches in ground-color of the underside of secondaries typical Labrador *aquilo*, but is normally much larger in size; the black dots of the post-median white band of secondaries are obsolescent, although present in the two costal spots; in *aquilo* these spots are generally quite evident; the dark submarginal lunules are also better defined in *aquilo*, especially toward the anal angle; the underside of primaries is as strongly marked as in *aquilo*, in fact even more so. The two females before me are less variegated with silvery spotting than is usual in *aquilo* but this feature is probably variable. From the Colorado variety, *rustica* Edw., *megalo* is easily separated by the dark ground-color of underside and from the Californian *podarce* Feld., among other things, by the lack of distinct black spotting on the underside of secondaries. The type series is as follows:

Holotype—♂, Mt. McLean, Lillooet, B. C., July 12th (J. McDunnough); No. 2503 in the Canadian National Collection, Ottawa.

Allotype—♀, same data.

Paratypes—8♂, 1♀, same data.

Plebeius saepiolus Bdv. I did not find the species at Seton Lake, but took it sparingly at D'Arcy, Anderson Lake, on June 17th.

Plebeius icarioides montis Blkmre. This recently described race was very common on Mt. McLean in the open spaces at or near timber-line, flying together with *scudderi* Edw. The obsolescent nature of the dark spots on the underside of secondaries combined with the pale ground-color seems a good character; on the upper side the males are the same deep blue color as in *pembina* Edw.

Glaucopsyche lygdamus oro Scud. What I take to be this race of *lygdamus* appeared fairly common in July on the lower slopes of Mt. McLean above 4000 ft.; I only, however, secured two rather worn specimens, the undersides of which are too dark to be referred to *columbia* Skin.

Lycaenopsis pseudargiolus Bdv. & Lec. The spring race, *nigrescens* Fletch., was just over when I arrived at Seton Lake on May 27th; later on in the middle of June I captured odd specimens of the second generation which would appear best referred to *echo* Edw.; it was however nowhere common.

HESPERIIDAE

Hesperia centaureae Ramb. A single female was taken on Mt. McLean on July 11th. Whether our North American form should be referred to *centaureae* or to *freija* Warr. is a matter of some doubt; a comment on this has recently been made by Barnes and Benjamin in the Bulletin of the Southern California Academy of Sciences, Vol. XXV, Pt. 3.

Hesperia ruralis Bdv. One worn specimen was captured on June 1st; it was probably more common earlier in the season.

Pholisora catullus Fabr. Rather uncommon early in June.

Thanaos icelus Lint. Common all through the district in late May and June.

Thanaos callidus Grin. One male and one female taken May 27th and May 30th at Seton Lake were all the specimens I saw of this species.

Ochlodes sylvanoides Bdv. Not uncommon in early July.

Polites themistocles Latr. One female was captured at a marshy spot along an irrigation ditch on June 5th.

Amblyscirtes vialis Edw. Common at Anderson Lake, but not observed in the Seton Lake district.

(To be continued)

A REVISION OF THE SPECIES OF APHODIUS OF HORN'S SERIES I-b (COLEOPTERA).*

BY W. J. BROWN,
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The series I-b of Aphodius was erected by Dr. Horn for those of our species which have the fore tibia punctate on the anterior face and the first segment of the anterior tarsus longer than the second. Horn including two species, *rubeolus* and *stercorosus*, in this group, overlooking the fact that two additional species known to him, *lentus* and *tenuistriatus*, possessed these characters. Subsequently, *troglodytes* and *campestris* were described by Hubbard and Blatchley respectively. The present paper includes the six species noted above and adds two which are described as new. *Aphodius canadensis* Garnett, described as a member of this

*—Contribution from the Division of Systematic Entomology, Entomological Branch, Dept. of Agric., Ottawa.

group, is omitted, for in it the anterior tibia is impunctate, the first segment of the anterior tarsus is shorter than the second, and the pronotal side margins are explanate; the species is a member of series I-a.

The present series is quite homogenous. The small size, pale coloration, and constant form of the species impart to them a facies which is quite characteristic. In addition to the characters of the fore legs, the species agree in the following:

Small, elongate oval, moderately convex, shining, integument semi-transparent. Head moderately convex, without trace of tubercles. Clypeus hemihexagonal; very feebly emarginate; the angles on each side of emargination broadly rounded; the sides very feebly arcuate, oblique.

Genae broadly rounded, not prominent. Pronotum widest near the hind angles; the sides feebly arcuate, not explanate; hind angles well defined but obtuse, basal margin broadly arcuate. Scutellum small. Elytra slightly wider than pronotum; widest at middle; the sides feebly arcuate; the humeri obtuse; the striae fine, punctate; the intervals flat, sometimes pubescent. Mesosternum opaque in front, carinate between the coxae. Hind tibia fimbriate with unequal spinules.

KEY TO SPECIES.

1. Pronotum with basal marginal line; color variable ..... 2.
   Pronotum without basal marginal line; color brownish, the elytra paler ..... *stercorosus* Melsh.
2. Elytra pubescent, at least near the margins ..... 3.
   Elytra without trace of pubescence ..... 6.
3. Pubescence of elytra confined to apical third near margin ..... 4.
   Elytra pubescent throughout ..... 5.
4. First segment of hind tarsus distinctly shorter than the three following together; color uniformly reddish ..... *rubcolus* Beauv.
   First segment of hind tarsus as long as the three following together; color brownish, the elytra yellow ..... *campestris* Blatch.
5. Pronotum strongly, rather closely punctate at middle, the median line impunctate on basal half, the sides not fimbriate ..... *lentus* Horn.
   Pronotum very finely and sparsely punctate at middle, the median line not impunctate, the sides fimbriate ..... *tenuistriatus* Horn.
6. Pronotal punctures all very fine; inhabiting tortoise burrows *troglodytes* Hub.
   Pronotal sides with intermixed large and small punctures; inhabiting prairie dog burrows ..... 7.
7. Punctures of elytral intervals as coarse as those of the striae; color dark brownish red ..... *cynomysi* n. sp.
   Punctures of elytral intervals finer than those of the striae; color reddish yellow to pale brownish red ..... *cavidomus* n. sp.

Aphodius stercorosus Melsheimer.

Melsheimer, Proc. Acad. Nat Sci. Phila., II, 136, 1844.
Horn, Trans. Am. Ent. Soc., III, 127, 1870.
Horn, Trans. Am. Ent. Soc., III, 126, 1870.
Blatchley, Coleop. Ind., 932, 1910.

Length 3.3-4.4 mm.; brownish yellow; the head, pronotum and elytral suture brownish, the elytra sometimes clouded with brownish. Head slightly more

than two-thirds as wide as pronotum, distinctly and uniformly punctate throughout, the punctures finer and separated by distances equal to three times their own diameters, frontal suture distinct.

Pronotum slightly more than two-thirds as long as wide; sides not fimbriate; the punctures very fine and sparse at middle, rather close and very unequal on the sides; base without marginal line.

Elytral striae rather coarsely and closely punctate; intervals with a few very fine punctures, apparently impunctate, distinctly alutaceous at apex.

Mesosternum distinctly carinate between the coxae. Metasternum and abdomen sparsely, finely punctate, the former alutaceous at sides and the latter feebly so throughout. Middle and hind femora with a few very fine punctures. Anterior tibia denticulate above the upper tooth. Posterior leg very slender, the first tarsal segment slightly longer than the three following together.

The sexual characters described by Dr. Horn are not apparent in the long series at hand. There is variation in the pronotal puncturation, but it seems to be independent of sex. It is probable that Dr. Horn had *campestris* before him when he described the elytra of the present species as pubescent on the sides near the apex.

The species occurs from Quebec (Joliette and Chambly Counties) and Florida west to Colorado and Texas. It is common beneath manure and prefers sandy soil.

Aphodius rubeolus Beauvois.

Beauvois, Ins. Afr. et Amer., 90, 1805.
Melsheimer, Proc. Acad. Nat. Sci. Phila., II, 136, 1844.
Horn, Trans. Am. Ent. Soc., III, 126, 1870.
Horn, Trans. Am. Ent. Soc., XIV, 34, 1887.
Blatchley, Coleop. Ind., 932, 1910.

Length 3.3-4.5 mm.; brownish red. Head almost three-fourths as wide as pronotum; uniformly punctate throughout, the punctures very fine, sparse, and indistinct; frontal suture distinct.

Pronotum almost three-fourths as long as wide; sides fimbriate with very short hairs; punctures very sparse, fine and indistinct at middle, closer and very unequal on the sides; base with fine marginal line.

Elytral striae rather finely, not closely punctate; intervals with a few very fine punctures, apparently impunctate, not alutaceous, with short yellow hairs near margin on apical third. Mesosternum distinctly carinate between the coxae. Metasternum with a few very fine punctures at middle, feebly alutaceous on the sides. Abdomen finely, sparsely punctate. Middle and hind femora with a few very fine and indistinct punctures, each with several coarse punctures at apex. Anterior tibia denticulate above the upper tooth. Posterior leg very stout, the first tarsal segment distinctly shorter than the three following together. Sexual characters absent.

The range of the species is that of *stercorosus*. It occurs beneath manure and is common only on sandy soil.

Aphodius campestris Blatchley.

Blatchley, Can. Ent., XLIV, 330, 1912.

Length 3.3-3.9 mm.; brownish yellow; the head, pronotum and elytral suture brownish. Head slightly more than two-thirds as wide as pronotum; uni-

formly punctate throughout, the puncturation very indistinct, fine, and sparse; frontal suture distinct.

Pronotum slightly more than two-thirds as long as wide; sides fimbriate; punctures very fine, sparse, and indistinct at middle, larger, closer, and unequal on the sides; base with fine marginal line.

Elytral striae rather closely punctate, the punctures fine but distinct; intervals very feebly alutaceous throughout, each with two rows of very fine and indistinct punctures, pubescent near margin on apical third, the short yellow hairs arising from punctures which are more distinct than those of the disk.

Mesosternum rather feebly carinate between the coxae. Metasternum and abdomen sparsely punctate, the former alutaceous on the sides. Middle and hind femora with a few indistinct punctures. Anterior tibiae crenate above the upper tooth. Posterior leg stout, the first tarsal segment equal in length to the three following together. Sexual characters absent.

The species occurs in Florida beneath manure on sandy soil.

Aphodius lentus Horn.

Horn, Trans. Am. Ent. Soc., III, 125, 1870.
Horn, Trans. Am. Ent. Soc., XIV, 27, 1887.
Blatchley, Coleop. Ind., 931, 1910.

Length 3.4-3.6 mm.; reddish brown; head and pronotum darker; feebly shining. Head slightly more than three-fourths as wide as pronotum; very distinctly punctate, the punctures rather fine and separated by distances about twice as great as their own diameter, finer and less close near clypeal emargination; vertex narrowly impunctate; frontal suture distinct.

Pronotum three-fourths as long as wide; sides not fimbriate; puncturation uniform throughout, the punctures unequal and rather close; median line narrowly impunctate on basal half; base with strong marginal line.

Elytral striae coarse, rather coarsely, not closely punctate; intervals alutaceous throughout, each with two rows of punctures, each puncture bearing a short yellow hair.

Mesosternum finely carinate between the coxae. Metasternum and abdomen finely, sparsely punctate. Middle and hind femora with a few very fine punctures. Anterior tibia strongly crenate above the upper tooth. Posterior leg rather stout, the first segment of the tarsus equal in length to the three following together. Sexual characters absent.

The species is recorded from Quebec (Terrebonne and Chambly Counties), Pennsylvania, Massachusetts, Illinois, Georgia, Kansas, and Nebraska.

Aphodius tenuistriatus Horn.

Horn, Trans. Am. Ent. Soc., XIV, 60, 1887.

Length 3.4-4.7 mm.; pale brownish red; head, pronotum and elytral suture darker; rather feebly shining. Head slightly more than two-thirds as wide as pronotum; uniformly punctate throughout, the punctures very fine and sparse; frontal suture distinct.

Pronotum slightly more than two-thirds as long as wide; side margins fimbriate; surface punctate throughout; the punctures as fine and sparse at middle as those of the head, coarser, closer, and unequal on the sides; base with fine marginal line; side margins fimbriate; disk pubescent near hind angles.

Elytral striae very indistinctly punctate; intervals each with two rows of feeble punctures, each puncture bearing a short, yellow hair, the intervals feebly alutaceous at apex.

Mesosternum distinctly carinate between the coxae. Metasternum and femora with a few punctures, the former feebly alutaceous on the side. Abdomen sparsely and finely, but distinctly, punctate. Anterior tibia strongly crenate above the upper tooth. Posterior leg rather stout, the first segment of the tarsus slightly shorter than the three following together. Sexual characters absent.

The species is common in Kansas, Oklahoma, and Texas where it occurs beneath manure on sandy soil.

Aphodius troglodytes Hubbard.

Hubbard, Insect Life, VI, 312, 1894.

Length 3.4-3.8 mm.; pale reddish yellow; the elytral suture slightly darker. Head two-thirds as wide as pronotum; uniformly punctate throughout; the punctures very fine, sparse, and indistinct; frontal suture distinct.

Pronotum less than two thirds as long as wide; the sides not fimbriate; surface very indistinctly punctate; the punctures very fine and sparse, closer on the sides but not unequal; base with fine marginal line.

Elytral striae feebly punctate; intervals with a few very fine, indistinct punctures, not alutaceous at the apex.

Mesosternum finely carinate between the coxae. Puncturation of ventral surface and femora very fine, sparse, and indistinct. Anterior tibia not crenate above the upper tooth. Posterior femora and tibiae rather stout, the tarsus very long and slender, its first segment equal in length to the three following together. Sexual characters absent.

The species occurs in Florida in the holes of the gopher tortoise.

Aphodius cynomysi n. sp.

Length 3-3.6 mm.; dark brownish red; ventral surface and legs paler, strongly shining. Head two-thirds as wide as the pronotum; very distinctly punctate, the punctures rather fine and separated by distances about twice as great as their own diameters, finer and more sparse at middle; frontal suture very faintly indicated or invisible.

Pronotum two-thirds as long as wide; sides not fimbriate; surface punctate throughout; the punctures fine and sparse at middle, coarser, closer, and unequal on the sides; base with fine marginal line.

Elytral striae rather closely, finely punctate; intervals feebly alutaceous, more strongly so near apex; very distinctly punctate, the punctures as large as those of the striae, equal in size, and as closely spaced as those of the pronotum at middle.

Mesosternum feebly carinate between the coxae. Metasternum sparsely and finely punctate at middle, alutaceous on the sides. Abdomen sparsely, indistinctly punctate; very feebly alutaceous. Middle and hind femora with a few indistinct punctures. Anterior tibiae very feebly crenate above the upper tooth. Posterior leg slender, the first segment of the tarsus equal in length to the three following together. Sexual characters absent.

Holotype—Otoe Pasture, Noble Co., Okla., June 21, 1926. (W. J. Brown); No. 2504 in the Canadian National Collection, Ottawa.

Paratypes—15, Otoe Pasture and 101 Ranch, Noble Co., Okla., June 29, 1926. (W. J. Brown and G. A. Bieberdorf).

This species occurs with *cavidomus* in the burrows of the common prairie dog.

Aphodius cavidomus n. sp.

Length 3.2-4.3 mm.; reddish-yellow to pale brownish-red; the elytral suture and sometimes head and pronotum slightly darker. Head slightly more than two-thirds as wide as pronotum; distinctly punctate throughout, the punctures fine and separated by distances about three times as great as their own diameters, less close on the vertex; frontal suture faintly indicated.

Pronotum slightly more than two-thirds as long as wide; sides not fimbriate; surface punctate throughout; the punctures very fine, sparse and often indistinct at middle, coarser, closer, and unequal on the sides; base with very fine marginal line.

Elytral striae rather closely, finely punctate; intervals very finely, sparsely, and often indistinctly punctate, alutaceous at apex.

Mesosternum distinctly carinate between the coxae. Metasternum indistinctly, very sparsely and finely punctate at middle, alutaceous on the sides. Abdomen very sparsely punctate. Middle and hind femora with a few very fine and indistinct punctures. Anterior tibia feebly or not crenate above the upper tooth. Posterior leg slender, the first segment of the tarsus equal in length to the three following together.

Holotype—Otoe Pasture, Noble Co., Okla., June 29, 1926 (W. J. Brown); No. 2505 in the Canadian National Collection, Ottawa.

Paratypes—90, Otoe Pasture and 101 Ranch, Noble Co., Okla., June 21, 28, and 29, 1926 (W. J. Brown and G. A. Bieberdorf).

The larger specimens in the series at hand are slightly darker in color and more indistintly punctate. These are males, but the characters are not constant enough to permit accurate separation of the sexes. The type is one of the smaller examples with a distinctly punctate dorsum. The species occurs with *cynomysi* in the burrows of the common prairie dog.

THE GENUS JASSUS IN AMERICA NORTH OF MEXICO. (CICADELLIDAE HEMIP.)*

BY PAUL B. LAWSON,

Lawrence, Kans.

The genus Jassus is a very large genus of leafhoppers known to occur over a very large portion of the earth. Many species have been described from India, Africa, Central and South America, the Phillipines and several other countries. A very few species, however, seem to occur in America north of Mexico. Since only one of these species is well known, two but slightly known, and two apparently new to science, the writer feels that a short paper introducing us to the small part of the genus known to occur in the United States would not be out of place. A paper on the other American species is being prepared and should be ready for publ[illegible]ion before long.

*—Contribution from the Department of Entomology, University of Kansas.

COLOR VARIATIONS WITHIN THE SPECIES:

In studying the members of this genus it soon became apparent that a great deal of color variation may occur within the species. This is readily seen when one examines a representative group of specimens of *Jassus olitorius* Say. In this species there appears to be a distinct dimorphism of males, if only the extremes of coloring are studied, one form tending to be quite dark brown, sometimes almost black, so that the yellow vertex is very conspicuous; the other being much lighter, in extreme cases almost a yellowish-brown, the vertex, pronotum and elytra being of almost the same color. The former type was evidently before Spangberg when he described *Jassus fuscipennis*. Between these extreme types there are all gradations of color, so that it is very difficult to ascribe any definite color to the males. Moreover in size there is also a very considerable variation in the males. The females also vary in size, but as in the males, much more so in color. Some are a light brown; others almost as dark as the darkest males. In most of them the two pale bands across the elytra are quite distinct; in many, however, they are scarcely discernible. In *Jassus borealis* Spangberg a very great range of variation is also evident. Most of the males and a large part of the females are practically unicolorous and a rusty-brown in color. However, this brown may become distinctly darker till the entire specimen is uniformly dark brown. In still other cases the general color of the insect may not be darkened, but the veins may be, till they stand out very distinctly against the lighter background, and in some cases darkened areas may be found on the elytra between the veins. In some cases there is a vague light band across the elytra beyond the clavus, though in the males, and some females, there seems to be no sign of it.

The above is enough to indicate something of the problem one meets in attempting to separate the several species of the genus. Because of this wide variation in color and the similarity of the general appearance of some of the species, the writer has attempted a somewhat detailed study of the specific characters of these five species, especially with reference to the genitalia, both male and female.

THE MALE GENITALIA

In many genera of Cicadellids the genital plates of the male are of great value in separating the species. In the genus Jassus, however, they have been little used due to the fact that they do not extend below the pygofer in the usual horizontal plane, but are always more or less distinctly vertically inclined. If dissected out, however, they are found to be of characteristic shape in the several species. In their chaetotaxy also they show specific characters which may be used occasionally in the separation of difficult species.

In the pygofer of the male there are at least two characters which may be used in systematic work. As shown by the drawings the shape of the pygofer varies considerably for the several species, and the number, size and position of the long hairs borne by them gives a very striking character which may be readily used.

The so-called "internal genitalia" are also quite definite for each species. The genital claspers are quite distinctive, at least apically. Their enlarged

bases are found to vary within the species. A superficial examination seems to show that this part of the clasper is laid down more or less concentrically and that the variations are probably due to differences in the extent of their development. The ventral or main part of the oedeagus is also quite characteristic in each of the species, the unusual form in *J. snowi* indicating that a subdivision of the genus may be desirable when the species of other countries have been fully studied. Altogether the various male genitalia afford splendid aid to the taxonomist in his study of the genus.

THE FEMALE GENITALIA

In the female the last ventral segment of the abdomen is in many genera of Cicadellidae of distinctive value. In this genus some writers have made much use of it and others but little. In some species it is quite distinctive, but in many others the differences are quite minute, so that this character is not of as much value as in many other genera. In addition to using the last ventral segment of the abdomen, it was thought that though they would not usually be of much practical value in separating the species, yet the valves of the ovipositor might be also used or that a study of these valves might at least be of scientific interest in showing specific differences. This study revealed that such differences do occur in all three pairs of valves and that in possible cases, as a last resort, they may be found helpful.

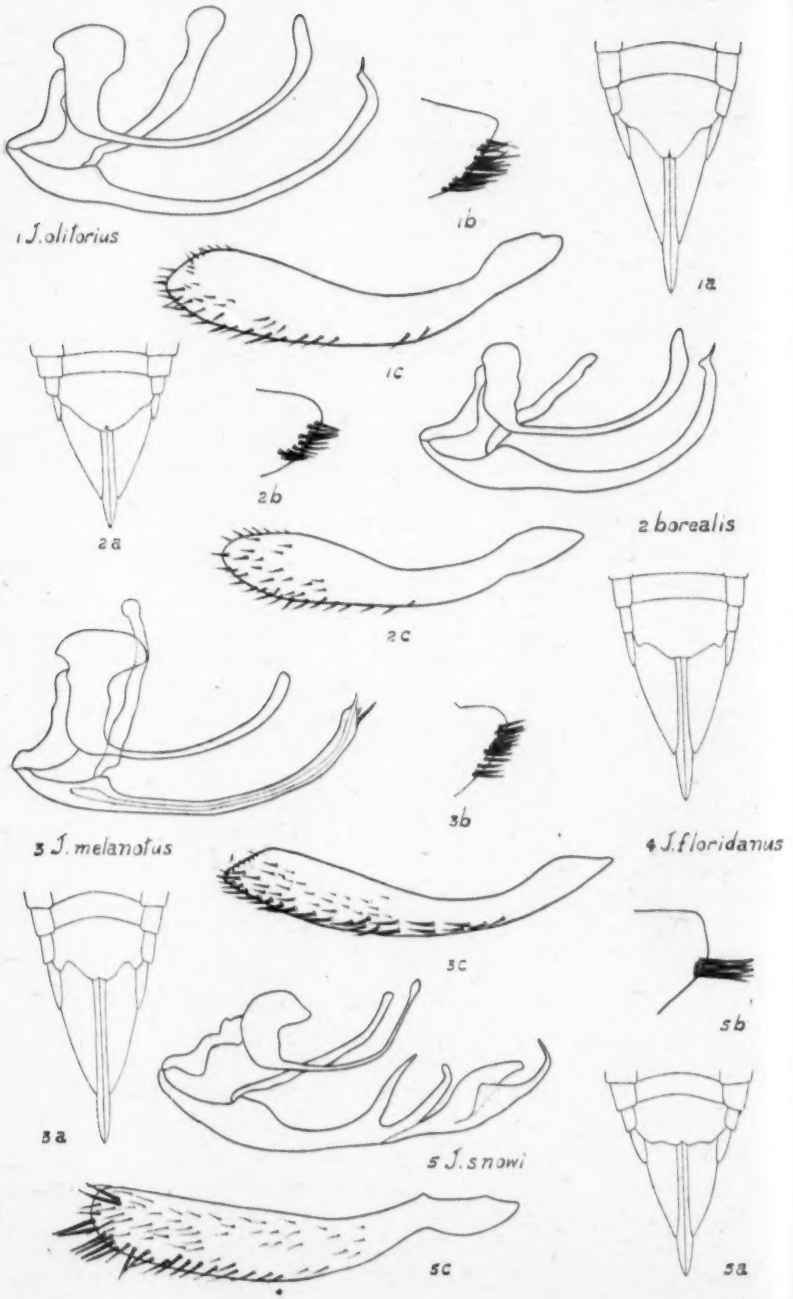
The general anatomy of these valves is now well known. The outer pair, commonly called the ovipositor in descriptions, are really the lateral valves and arise from the ninth segment of the abdomen. The outlines of these valves are quite distinctive in the several species and even more definite are the differences in their chaetotaxy. While examining slides of these valves it was noticed that not only are the large marginal hairs of characteristic size, shape and distribution, but that the small microscopic hairs also vary in the several species in like manner. Moreover the extent to which the valves are covered with these hairs is quite definite in each species. Similar differences are evident in the small hairs to be found on the last ventral abdominal segment of the female.

The middle or ventral valves arise from the eighth segment. Each of these valves consists of a more heavily chitinized portion and a membranous part. The relative size of this membranous part differs in the various species as does the appearance of the tip of the chitinized part. This latter arrowhead-like part is marked by lines which give it the appearance of palmer skin. It is interesting to note that the fineness or coarseness of these lines seems to be constant for the species and somewhat different in the various species.

The inner or dorsal valves constitute the ovipositor proper and arise from the ninth segment. Only very minute microscopic differences are found in these valves in the several species. While specific differences are not strong in these valves, nevertheless their generic aspect seems to be very constant.

KEY TO SPECIES.

1. Costal margin distinctly lighter than rest of elytra .... *melanotus* Spangberg.
   Costal margin not distinctly lighter than rest of elytra ..... 2.
2. Lighter, grayish-brown species; dark brown veins strongly contrasting with cells of elytra and without light elytral bands ..... *snowi* sp. n.


1 J. oliforius
1b
1a
1c
2b
2a
2 borealis
2c
3 J. melanotus
3b
4 J. floridanus
3c
5b
3a
5 J. snowi
5c
5a

Darker, reddish-brown species; elytral veins not so distinct, elytral bands absent, faintly indicated or distinctly evident ..... 3.

3. Species varying from light to dark brown; females usually with two distinct transverse elytral bands ..... *olitorius* Say.
Reddish-brown species; with, at most, but one transverse elytral band .. 4.

4. Elytral band distinct; last ventral segment of female without distinct median notch ..... *floridanus* sp. n.
Elytral band at best indistinct, frequently lacking; last ventral segment of female with short but wide notch ..... *borealis* Spangberg.

Jassus melanotus Spangberg.

Figs. 3, 3a, 3b, 3c.

Jassus melanotus Spangberg, Of. Vet. Akad. Forh., XXXV, No. 8, p. 19, 1878.

A black species with costal margins of elytra light. Length 5.5-8 mm.

Head narrower than pronotum; vertex wider than long, narrowed basally, anterior margin slightly produced beyond eyes, longitudinal median line distinct, ocelli about twice as far from each other as from the eyes; front about twice as long as wide, with median carina; clypeus strongly widened apically, with median carina. Pronotum about as long as vertex, nearly three times as wide as long, sparsely but distinctly granulated. Scutellum large. Elytra with venation distinct, strongly exceedingly ovipositor. Last ventral segment of female about twice as long as preceding, lateral angles distinct, posterior margin strongly concave on either side of the produced median half which has no apical slit or notch; pygofer bearing a few fine hairs, strongly exceeded by ovipositor. Male plates long, bearing spines on apical two-thirds, apex acutely angled when viewed laterally; pygofer not angulate, bearing a considerable number of moderately large spines.

Color: Black when fully colored except for yellow vertex and light costal margins of elytra. Beneath mostly yellow, with coxae of hind legs and pygofer marked with black. Teneral forms dark brown to black with lighter line along elytral suture and light spots at tips of clavi.

Distribution: Specimens examined were taken in Ga., S. C., N. C., Miss., Tex., Tenn., Ill., and Ohio.

Hosts: Dr. H. L. Dozier reports taking this species on *Sagittaria*.

Remarks: Both sexes of this species are alike in color, but the male is distinctly smaller than the female. Some of the males of *J. olitorius* superficially resemble the males of this species, particularly in color, but lack the light costal margin on the elytra.

Jassus snowi sp. n.

Figs. 5, 5a, 5b, 5c.

A grayish-brown to dark brown species with veins contrasting strongly with cells of elytra. Length 6.5-8.5 mm.

Head narrower than pronotum; vertex wider than long, narrowed basally, obtusely rounding in front and slightly produced beyond the eyes, with distinct median impressed line, ocelli nearly twice as far from each other as from the eyes; front scarcely twice as long as wide, with a faint median carina; clypeus with median ridge, widened apically, apical margin concave. Pronotum about as long as vertex, nearly three times as wide as long, distinctly granulated. Scutellum

large, with transverse impression. Elytra exceeding the ovipositor, with very distinct venation. Last ventral segment of female about twice as long as preceding, posterior margin almost truncate and sinuated between lateral angles and the slightly produced median portion; pygofer bearing few fine hairs, strongly exceeded by ovipositor. Plates of male long and club-like, apices broadly rounded when viewed laterally, bearing a row of stout spines near mesal margin; pygofer bearing a small group of long black hairs.

Color: Vertex uniformly yellowish-brown, often bearing a pair of brown or red spots near base. Pronotum slightly darker than vertex, the granulations usually dark brown. Scutellum uniformly yellowish-brown or darker. Elytra nearly uniformly grayish-brown with very dark veins and posterior margin fuscous. Eyes black. Face nearly unicolorous yellowish-brown, sometimes with two bright red stripes along sides of front. Underside brown, usually well spotted with black.

Holotype and *allotype*, female and male respectively, from the Santa Rita Mts., Arizona. Taken by F. H. Snow. These types with many paratypes, deposited in the Snow Entomological Collection. Other paratypes deposited in the United States National Museum, Cornell University Collection, Museum of Comparative Anatomy, Cambridge, and in Dr. Ball's collection. All these types except the last which was taken in Lower California, Mexico, are from Arizona.

Remarks: This species, named in honor of Dr. F. H. Snow who collected most of the specimens, shows internal genitalia which are quite distinct from those found in the other species from the United States. These genitalia would indicate that it belongs to a different subgenus.

Jassus olitorius Say.

Figs. 1, 1a, 1b, 1c.

Jassus olitorius Say, Jl. Acad. Nat. Sci. Phila., vi, p. 310, 1831; Compl. Writ., ii, p. 385.

A light brown to dark brown species. Females with two light transverse bands. Length 6-8.5 mm.

Head narrower than prothorax; vertex wider than long, widened apically, anterior margin but slightly produced beyond the eyes, median impressed line distinct, ocelli about twice as far from each other as from the eyes; front about twice as long as wide, with median carina; clypeus widened apically. Pronotum a little longer than vertex, nearly three times as wide as long, sparsely but distinctly granulated. Scutellum large, wider than long. Elytra distinctly veined, strongly exceeding ovipositor. Last ventral segment of female over twice as long as preceding, lateral angles distinct, posterior margin strongly produced medially and bearing a narrow apical slit; pygofer bearing a few fine hairs and strongly exceeded by ovipositor. Male plates quite long, quite spiny on apical half and with apex obtusely angled when viewed laterally; pygofer sharply angulate apically and bearing a large group of fairly long hairs.

Color: Varying from practically uniform pale brown to almost black. Females light to dark brown. Vertex usually yellow. Pronotum darker, frequently with basal angles and two spots before transverse impression, black. Elytra with veins darker than cells, sometimes black, and with a light band across middle of clavus and a more prominent one through anteapical cells. Face yellow, with frontal sutures below the antennae frequently darkened and some-

times with two red stripes along margins of front. Males showing definite color dimorphism. In both forms vertex yellow. Light form yellowish-brown with elytra becoming slightly smoky; dark form with black pronotum, scutellum and elytra, the latter becoming slightly lighter apically.

Distribution: The writer has seen specimens from the following states: Ark., Tenn., Kans., Mo., N. J., N. Y., Mass., Me., Va., W. Va., Ia., Fla., Mich., Ga., Tex., Md., Ill., Ala., Wisc., N. C., S. C., Pa., Minn., Miss., La., and from Washington, D. C. and Ontario. Van Duzee also reports it from Arizona and the Bermudas. The species is thus known to occur throughout the eastern half of the United States. There is some question whether the reference to Arizona should apply to this species or to the new species described above.

Hosts: Seemingly a rather general feeder. The writer has frequently taken nymphs on several species of oak and very commonly also on *Ambrosia trifida*.

Remarks: It seems quite clear that Spangberg had a dark male of this species before him when he described *Jassus fuscipennis*. This is the only common and well known member of the genus in the United States.

Jassus floridanus sp. n.

Figure 4.

Close to *J. melanotus* Spangberg, but reddish-brown in color and with a light transverse band across elytra through anteapical cells. Length 7.5 mm.

Head narrower than prothorax; vertex wider apically than long, narrowed at base, obtusely rounded in front and slightly produced beyond the eyes, with distinct median impressed line, ocelli about twice as far from each other as from the yes; front about twice as long as wide, with a faint median carina; clypeus narrowed immediately below base, gradually widened to below middle, and then suddenly and strongly widened to two large apical lobes, the apex distinctly concave. Pronotum about as long as vertex, three times as wide as long, with small but distinct granulations. Scutellum large with transverse impression at about middle. Elytra exceeding the ovipositor, with venation distinct. Last ventral segment of female over twice as long as preceding, lateral angles acute, posterior margin strongly produced medially, but without notch or slit; pygofer bearing a very few short, scattered hairs, strongly exceeded by ovipositor.

Color: Vertex and face brownish-yellow; eyes black; pronotum and scutellum nearly uniformly reddish-brown, lateral angles of latter slightly darkened. Elytra with clavi reddish-brown, the rest smoky-brown except for distinct light band which is widest on costal margins and extends to middle anteapical cell on each side; veins, except on claval area, for the most part dark brown or black. Underside nearly uniformly yellow except for darker pygofer and ovipositor and patch on metathorax. Wings smoky with black veins.

Holotype, female, Gainesville, Fla. Taken by C. J. Drake. Type in collection of Dr. H. O. Osborn.

Remarks: Except for color this species is very close to *J. melanotus*. The costal margins of the elytra, however, are darker than in the darkest specimens of that species and the lateral angles of the last ventral segment of the female are

not as strongly produced as in *melanotus*. Moreover there is a distinct, light elytral band in this species, no signs of which occur in Spangberg's species.

Jassus borealis Spangberg.

Figs. 2, 2a, 2b, 2c.

Jassus borealis Spangberg, Of. Vat. Akad. Forh., xxxvi, No. 6, 24, pl. 16, fig. 8, 879.

A rusty-brown to dark brown species. Length 5.5-8 mm.

Head narrower than pronotum; vertex wider than long, narrowed basally, anterior margin but slightly produced beyond the eyes, median longitudinal line distinct, ocelli about twice as far from each other as from the eyes; front about twice as long as wide, with median carina; clypeus strongly expanded apically, with median carina, apex strongly concave. Pronotum no longer than vertex, fully three times as wide as long, sparsely but distinctly granulated. Scutellum large, wider than long. Elytra usually but slightly longer than ovipositor. Last ventral segment of female over twice as long as preceding, lateral angles distinct but posterior margin not deeply concave either side of the produced median half which has a distinct short and rather wide notch at its apex; ovipositor strongly exceeding finely and sparsely haired pygofer. Male plates long, haired apically, apex rounded when viewed laterally; pygofer quite well rounded apically, bearing a fair sized group of moderately long spines.

Color: Practically uniformly rusty-brown to dark brown. Vertex usually yellow with two dark or reddish spots caudad of middle. Scutellum sometimes with basal angles and two spots cephalad of transverse line, black. Elytra unicolorous or with veins darker, sometimes with a very faint light band across middle of clavus and another through the apices of the anteapical cells; tips of elytra and wings sometimes banded with fuscous. Underside varying from brown to black, face sometimes with two red stripes extending on to median carina of clypeus.

Distribution: The writer has examined specimens of this species from Florida, Georgia and South Carolina.

Remarks: This species, as described above, fits Spangberg's description of *J. borealis* in every detail except that the ovipostor does not extend beyond the elytra as shown in his figure. Since the resemblance is so close in every other way, however, there seems to be no question about the correctness of this determination.

Mailed, Monday, July 25th, 1927.